PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-167886
(43)Date of publication of application : 23.06.1998

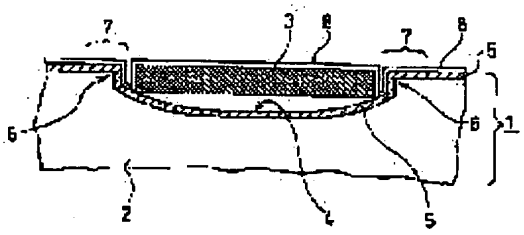
(51)Int.Cl. C30B 25/12
C23C 16/44
H01L 21/205

(21)Application number : 08-333563
(22)Date of filing : 13.12.1996

(71)Applicant : TOYO TANSO KK
(72)Inventor : HIRANO HIROYUKI
YOSHIMOTO YOSHIAKI
HOSOKAWA TOSHIHIRO
OKADA MASAKI

(54) SUSCEPTOR FOR VAPOR GROWTH

(57)Abstract:
PROBLEM TO BE SOLVED: To provide the susceptor by which a semiconductor is not contaminated and which has a long service life.
SOLUTION: This susceptor comprises a graphite base material 2 in which a countersunk concave part 4 for receiving and placing a semiconductor wafer 3 is formed and also, the surface of which is coated with a silicon carbide film 5 by a CVD(chemical vapor deposition) method. In the susceptor, of the surface of the graphite base material 2 or the coated surface with the silicon carbide film 5, at least a region 7 equivalent to the whole peripheral upper surface of an upper edge corner part 6 of the countersunk concave part 4 is formed so as to have a surface roughness value smaller than that of any region of the surface of the graphite base material 2 or the coated surface with the silicon carbide film 5, other than the region 7.



LEGAL STATUS
[Date of request for examination] 09.12.2003

[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3887052
[Date of registration]	01.12.2006
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the susceptor for vapor growth from which the silicon carbide film was covered with the CVD method by the front face of a graphite base material in which the spot facing crevice for carrying out receipt installation of the wafer was formed The inside of the front face with which the front face or said silicon carbide film of said graphite base material was covered, The susceptor for vapor growth characterized by being formed and becoming as the surface roughness of the field which is equivalent to the top-face perimeter of the upper limb corner of said spot facing crevice at least becomes smaller than the surface roughness of the graphite base material front face of the other field, or the surface roughness of a silicon carbide film covering surface.
[Claim 2] Maximum surface roughness Rmax as used in the field of JISB0601 of the field equivalent to the top-face perimeter of the upper limb corner of said spot facing crevice Susceptor for vapor growth according to claim 1 which is 8-25 micrometers.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In case this invention grows up an epitaxial film into semi-conductor wafers, such as a silicon wafer, with a CVD method, it relates to the susceptor for vapor growth for carrying out receipt installation of the semi-conductor wafer.
[0002]
[Description of the Prior Art] Conventionally, in order for this kind of susceptor for vapor growth (only henceforth a "susceptor") to establish two or more circular spot facing crevices which carry out receipt installation of the semi-conductor wafer in the susceptor body which uses carbon, such as a graphite, as a base material, and to emit the occluded gas of a susceptor body during epitaxial processing and not to pollute a semi-conductor wafer, what coated fixed thickness with the SiC film by the CVD method beforehand is use to a susceptor body.
[0003] For example, drawing 2 is the important section cross-section explanatory view after presenting epitaxial growth processing with the conventional susceptor, and in this drawing, in the top face of the susceptor body 22 with which a susceptor 21 consists of a graphite, more than one are prepared so that that pars basilaris ossis occipitalis may present [the circular spot facing crevice 24 which carries out receipt installation of the semi-conductor wafer 3] the shape of the concave spherical surface, and coating of the SiC film 25 is carried out to the front face of a susceptor 21 on it.
[0004] The epitaxial growth phase (semiconductor material layer formed at the epitaxial growth process) 30 which applied and followed the front face of the semi-conductor wafer 3 from the front face of a susceptor 21 is formed by setting the semi-conductor wafer 3 to this susceptor 21, and presenting epitaxial growth processing.
[0005]
[Problem(s) to be Solved by the Invention] However, in the conventional susceptor 21, when the semi-conductor wafer 3 was used for epitaxial growth processing, while repeat use was carried out, the problem that a crack 28 occurred in response to the effect of the repeat of a heat cycle into the part applied to the side-attachment-wall peripheral surface 27 from the top face of the upper limb corner 26 of the spot facing crevice 24 was. And when the notching wafer 29 produced according to generating of a crack 28 contacted the front face of the semi-conductor wafer 3, there was a problem that a blemish was attached to the epitaxial growth phase 30 of the front face. Moreover, when the carbon base material 22 is exposed, there is also a problem that the semi-conductor wafer 3 is polluted by the emission gas from the susceptor body 21.
[0006] This invention is made in view of this situation, and the place made into the purpose is in the point of offering the susceptor made polluting a semi-conductor wafer and prolongation-of-life-ized, as a crack does not occur into the part applied to a side-attachment-wall peripheral surface from the top face of the upper limb corner of the spot facing crevice for wafer receipt installation.
[0007]
[Means for Solving the Problem] The result which this invention persons investigated from various include angles about the cause which said crack generates, To the top-face perimeter of the upper limb corner of the spot facing crevice where receipt installation of the semi-conductor wafer is not carried out at an epitaxial growth process The condition (equivalent to 31 of drawing 2) that the semi-conductor film rose more

thickly than that perimeter is formed, it is easy to generate the stress concentration by the heat cycle into the part of this annular semi-conductor film that rose more thickly, it has become it, it found out that this was the cause, and this invention was completed.

[0008] Namely, invention according to claim 1 sets a wafer among this inventions to the susceptor for vapor growth from which the silicon carbide film was covered with the CVD method by the front face of a graphite base material in which the spot facing crevice for carrying out receipt installation was formed. The inside of the front face with which the front face or said silicon carbide film of said graphite base material was covered, It is characterized by being formed and becoming, as the surface roughness of the field which is equivalent to the top-face perimeter of the upper limb corner of said spot facing crevice at least becomes smaller than the surface roughness of the graphite base material front face of the other field, or the surface roughness of a silicon carbide film covering surface.

[0009] Thereby, since formation of the semi-conductor film is controlled, only the part of the amount of the semi-conductor film of the part of formation by which surface roughness is made smaller by the top-face perimeter of the upper limb corner of a spot facing crevice at the time of epitaxial growth will decrease, and it will become comparable as the perimeter as a result. That is, since it stops generating the phenomenon in which it is more thickly formed in the condition that the semi-conductor film rose rather than the perimeter to the top-face perimeter of the upper limb corner of a spot facing crevice like before, concentration of the stress by the heat cycle is also lost, therefore the phenomenon in which a crack occurs in the upper limb corner of a spot facing crevice is also lost. Consequently, a slip is generated to a semi-conductor wafer, being polluted is lost, and prolongation-of-life-ization of a susceptor can be attained.

[0010] Moreover, invention according to claim 2 is characterized by maximum surface roughness Rmax (less or equal "surface roughness Rmax" or it only being written as "Rmax".) as used in the field of JISB0601 of the field which is equivalent to the top-face perimeter of the upper limb corner of a spot facing slot among the configurations of invention according to claim 1 being 8-25 micrometers. Thereby, an effect of the invention according to claim 1 can be made much more certain and remarkable.

[0011]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. Drawing 1 is the important section cross-section explanatory view after presenting epitaxial growth processing with the susceptor concerning this invention. In drawing 1 , by spot facing processing, the circular spot facing slot 4 which carries out receipt installation of the semi-conductor wafer 3 on the top face of the susceptor body 2 with which a susceptor 1 consists of a graphite is formed for the pars basilaris ossis occipitalis so that the shape of the concave spherical surface may be presented. Moreover, surface roughness Rmax of the top-face perimeter 7 of the upper limb corner 6 of the spot facing crevice 4 after coating of the SiC film 5 with a thickness of about 30-300 micrometers was beforehand carried out to all the front faces of the susceptor body 2 by the CVD method It is polished so that it may become sufficiently smaller than the surface roughness of SiC film 5 covering surface of the other field. In addition, "the top-face perimeter 7 of the upper limb corner 6 of the spot facing crevice 4" means the field where the part which is equivalent to the flat-surface projected area of the upper limb corner 6 of the spot facing crevice 4 at least was secured.

[0012] After setting the semi-conductor wafer 3 in the spot facing slot 4 of this susceptor 1 and presenting epitaxial growth processing, the epitaxial growth phase 8 which applied and followed the front face of the semi-conductor wafer 3 from the front face of a susceptor 1 is formed. In this case, formation of the climax section 31 of the semi-conductor film formed in the top-face perimeter of the upper limb corner 26 of the spot facing crevice 24 in the conventional susceptor 21 shown in drawing 2 is not seen at all.

[0013] Consequently, the stress (for example, stress by the differential thermal expansion and residual stress in an epitaxial growth phase) generated between the epitaxial growth phase 8 and a susceptor 1 can avoid generating of the situation of concentrating on the upper limb corner 6 of the spot facing crevice 4, i.e., stress concentration. Therefore, generating of a crack (equivalent to 28 of drawing 2) conventionally made into the problem can be prevented, and the problem of slip generating and contamination of a semi-conductor wafer can be solved. Moreover, the life of susceptor 1 the very thing can be lengthened with generating prevention of a crack.

[0014] In addition, as a polishing condition of the top-face perimeter 7 of the upper limb corner 6 of the spot

facing crevice 4, it is surface roughness Rmax. It is desirable to be processed so that it may be set to 8-25 micrometers. Rmax It is because the cost which less than 8 micrometers takes at polishing while the depressor effect of the semi-conductor film generation by polishing is acquired mostly increases and it becomes uneconomical. On the other hand, it is Rmax. It is because polishing is inadequate, so it is generated also when the depressor effect of semi-conductor film generation is not necessarily enough, and it is also expected that a crack finally occurs and generating of such a situation is not desirable, if it exceeds 25 micrometers.

[0015] Moreover, implementation of thought called the surface eburnation of the top-face perimeter 7 of the upper limb corner 6 of the above-mentioned spot facing crevice 4 can be similarly obtained by the front face of the susceptor body 2 made from a graphite striking beforehand, polishing a considerable field part, and smoothing locally besides a means to polish SiC film 5 covering surface as mentioned above. Moreover, it is obtained also by changing the processing conditions of processing machines, such as an end mill.

[0016]

[Example]

(Example 1) It has the specific resistance of 12.5microomegam (at the time of a room temperature), and 12.0microomegam (1150-degreeC), and bulk density is 1800 kg/m3. After processing two or more isotropic graphites into discoid (the diameter of 705mm, thickness of 14mm), the spot facing crevice for wafer receipt installation was processed into the configuration similar to a wafer with an orientation flat with the end mill to each disc-like graphite member. Surface polishing was performed changing extent for the part (it is written as a "spot facing crevice circumference part" below.) of the top-face perimeter of the upper limb corner of a spot facing crevice about each disc-like graphite member using a sandpaper. The surface roughness of the spot facing crevice circumference part in each disc-like graphite member after polishing is shown in Table 1.

[0017] Next, the front face was made rude by covering the polishing part by the rubber plate member, and carrying out blasting of the other surface part by the silicon carbide particle. Furthermore, the susceptor body (equivalent to 1 of drawing 1) which consists of chlorine gas and a graphite base material which heated to 2400-degreeC in a fluorine gas ambient atmosphere, and carried out high grade processing was acquired. It covered the SiC film 60-micrometer 2 times at a time with the CVD method, changing a body supporting point to this susceptor body, and the target susceptor was obtained (sample susceptor No.**-** in Table 1). CVD conditions are [following] as ** - **.

[CVD conditions] -- :** material gas: -- trichlorosilane (SiHCl3), 2 chlorination ethene (C2 H2 Cl2), and hydrogen gas ** graphite base material temperature:1300 degreeC** furnace internal pressure:53kPa (it measures with a diaphragm type pressure gauge)

[0018] On the front face of the obtained susceptor, 200 micrometers of silicone films were grown up by using trichlorosilane (SiHCl3) and hydrogen gas as a raw material, and the thermal cycling test of 200-1200-degreeC was repeatedly performed until the crack occurred. The result is shown in Table 1.

[0019]

[Table 1]

サセプター No.	①	②	③	④	⑤	⑥	⑦
黒鉛基材の座ぐり凹部周辺部分の表面粗さ Rmax (μm)	45	35	30	25	20	12	8
クラック発生の状況	サイクル数200で発生あり	サイクル数230で発生あり	サイクル数260で発生あり	サイクル数390でも発生なし	サイクル数400でも発生なし	サイクル数400でも発生なし	サイクル数400でも発生なし

[0020] It is surface roughness Rmax of a spot facing crevice circumference part so that clearly also from Table 1. When being formed so that the conditions which are 8-25 micrometers may be fulfilled, also in 400 thermal cycling tests, it turns out that a crack is hardly generated.

[0021] (Example 2) After processing two or more graphite base materials more nearly disc-like than the graphite base material of the same property as an example 1 and forming a spot facing crevice like an example 1 to each disc-like graphite base material further, high grade processing of each graphite base

material was carried out by the same approach as an example 1. Furthermore, after covering silicon to each graphite base material, the susceptor body (equivalent to 1 of drawing 1) which heated to 1600-degreeC in the hydrogen ambient atmosphere, and converted 0.2mm of the surface into C/SiC composite was acquired (sample susceptor No.**-** in Table 2). It covered the SiC film 50-micrometer 2 times at a time with the CVD method to this body, changing a body supporting point. CVD conditions are as being shown in ** - ** below.

[CVD conditions] -- :** material gas: -- trichloromethyl silane (CH3 SiCl3) and hydrogen gas ** graphite base material temperature:1300-degreeC** furnace internal pressure: -- 50 kPa, further, to each acquired susceptor body, the spot facing crevice circumference part was polished for the spot facing slot periphery using various kinds of diamond particles, and the target susceptor was obtained.

[0022] Surface roughness Rmax of the spot facing crevice circumference part of each obtained susceptor It is shown in Table 2. 200 micrometers of silicone films were grown up like the example 1 on these susceptors, and the thermal cycling test of 200-1200-degreeC was repeatedly performed until the crack occurred. The result is shown in Table 2.

[0023]

[Table 2]

試料サセプター No.	①	②	③	④	⑤	⑥
Ｓｉｃ膜の座ぐり凹部周辺部分の表面粗さRmax (μm)	50	28	25	19	11	8
クラック発生の状況	サイクル数250で発生あり	サイクル数280で発生あり	サイクル数390でも発生なし	サイクル数400でも発生なし	サイクル数400でも発生なし	サイクル数400でも発生なし

[0024] It is surface roughness Rmax of a spot facing crevice circumference part so that clearly also from Table 2. When being formed so that the conditions which are 8-25 micrometers may be fulfilled, also in 400 thermal cycling tests, it turns out that a crack is hardly generated. Furthermore, even if the front face set from the result of an example 1 and an example 2 as the object of polishing is a front face of a graphite base material and it is a SiC film covering front face, it turns out that there is no change in the effectiveness as a susceptor.

[0025] Although the above-mentioned example took up and explained the susceptor of a sheet mold, the susceptor of this invention can be applied effective also in susceptors, such as a pancake mold and a barrel type, without being restricted to this sheet mold type.

[0026]

[Effect of the Invention] Among this inventions, according to the susceptor for vapor growth of invention according to claim 1, in a spot facing crevice circumference part, the degree of polishing is higher than a perimeter at the time of epitaxial growth, and since formation of the semi-conductor film is controlled only for the part by which surface roughness is made smaller, the amount of formation of the semi-conductor film of the part will become comparable as the perimeter as a result. That is, since it stops generating the phenomenon in which it is more thickly formed in the condition that the semi-conductor film rose rather than the perimeter into the spot facing crevice circumference part like before, concentration of the stress by the heat cycle is also lost, therefore the phenomenon in which a crack occurs in the upper limb corner of a spot facing crevice is also lost. Consequently, a slip is generated to a semi-conductor wafer, being polluted is lost, and prolongation-of-life-ization of a susceptor can be attained.

[0027] Moreover, invention according to claim 2 is surface roughness Rmax of the spot facing crevice circumference part among the configurations of invention according to claim 1. Since it was made to satisfy 8-25 micrometers, an effect of the invention according to claim 1 can be made much more certain and remarkable.

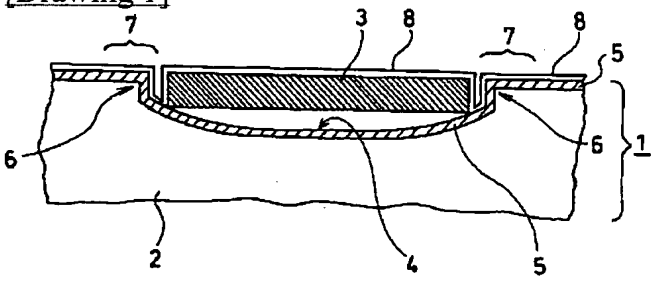
[Translation done.]

* NOTICES *

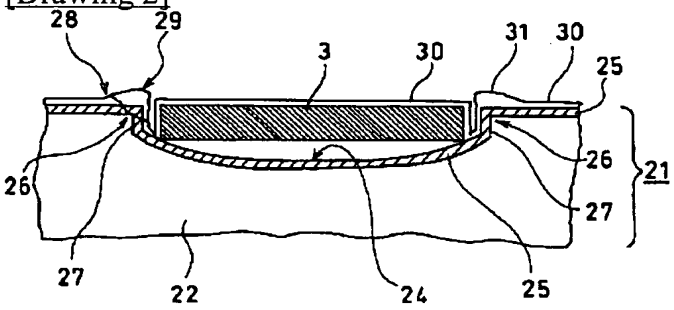
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]